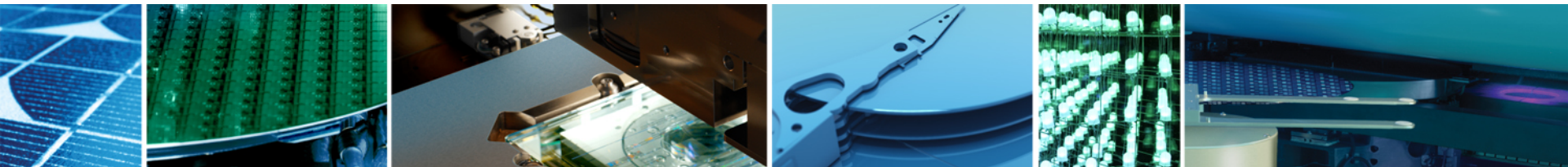
KLA-Tencor

Accelerating Yield

Automated Yield Management Solution for LED Manufacturing

DOE Agreement# DE-EE0003159

June 13, 2012



DOE Project Objectives & Scope

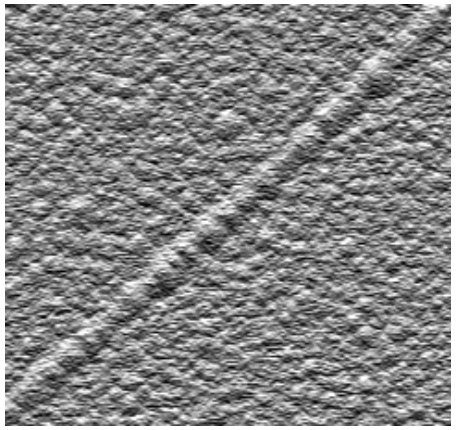
- Objective
  - Develop a comprehensive yield management system to enable automated process control in LED manufacturing
- Key Tasks
  - Extend detection sensitivity of yield-limiting defects for substrate and epi inspection platform
  - Accelerate root cause analysis in wafer fab process with comprehensive yield management solutions (YMS) analysis
- Team
  - KLA-Tencor – development of inspection HW and YMS SW platforms
  - Philips Lumileds – test samples and beta validation

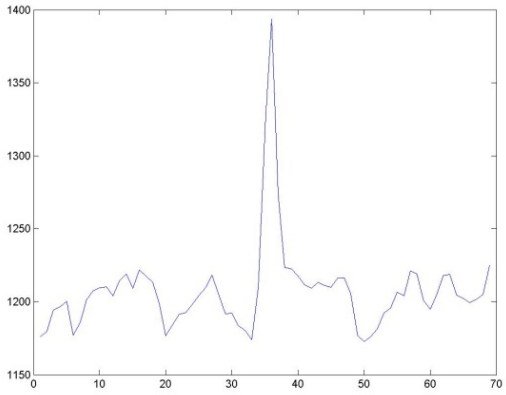
Project Scope - Hardware
Develop high sensitivity Candela inspection platform

Extend detection capability to critical yield-relevant and reliability defects

Improved detection of micro-scratches and cracks

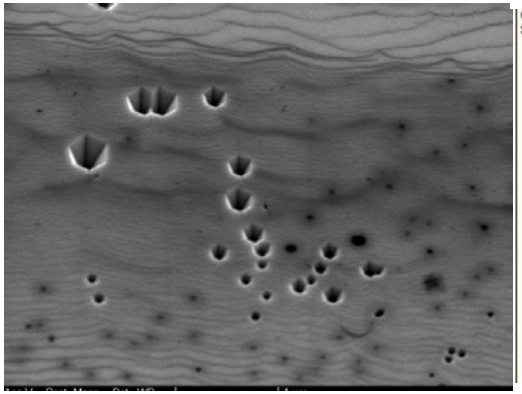
Substrate micro-scratches/ micro-cracks are known reliability defects that result in premature field failure

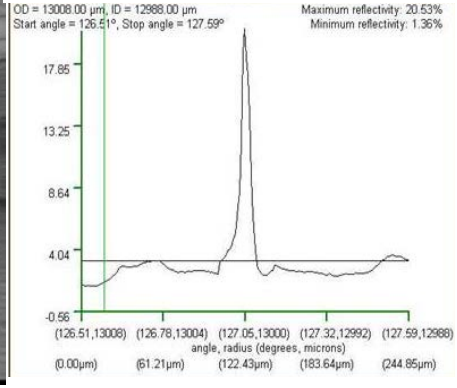




Improved detection of killer epi defects in sub-micron regime

Increase sensitivity and separation from nuisance particles

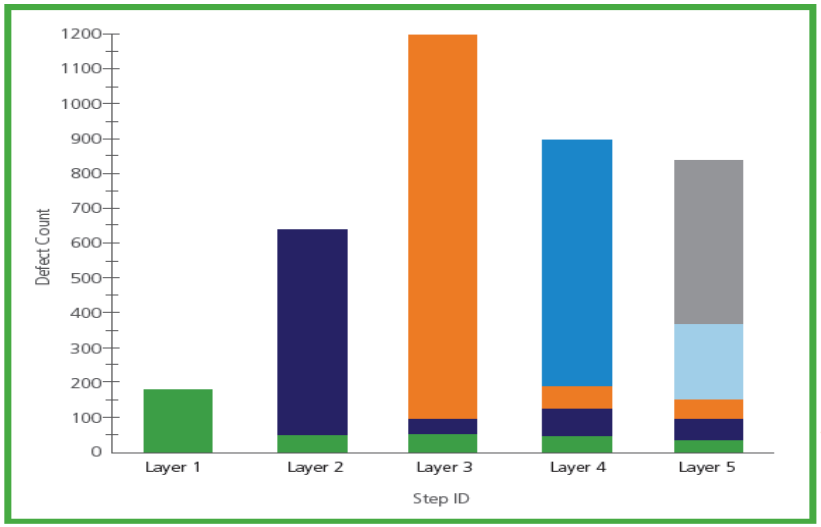


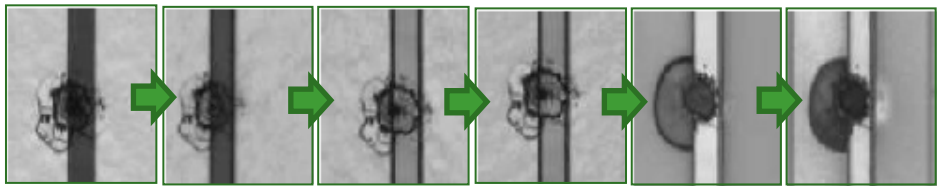


KLA-Tencor

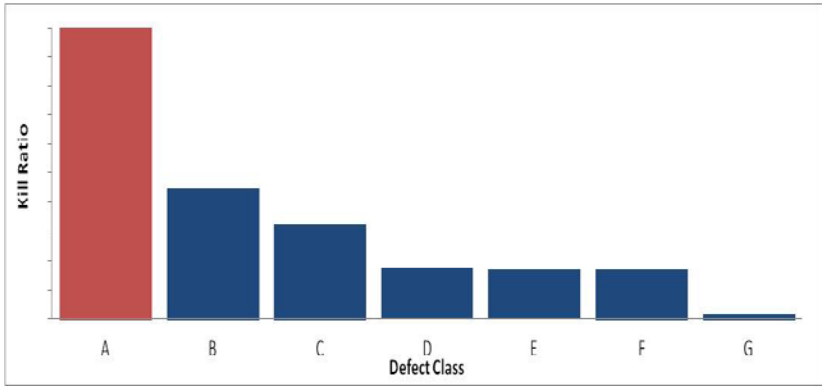
Project scope – Software
Correlation of inspection results in LED manufacturing

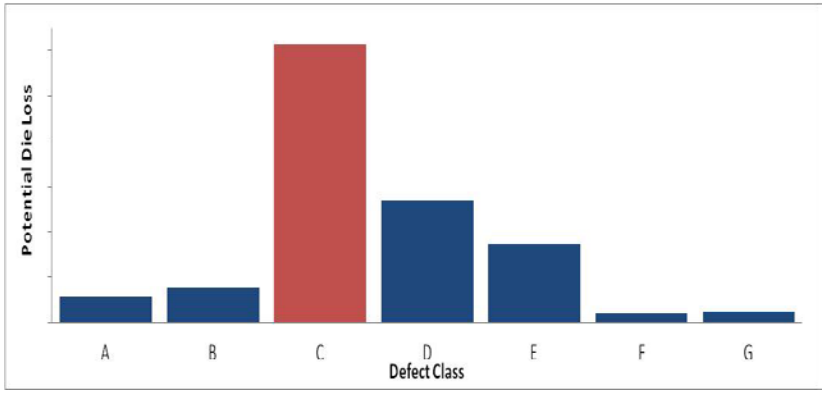
Defect Source Analysis (DSA)
Step contribution and defect transition





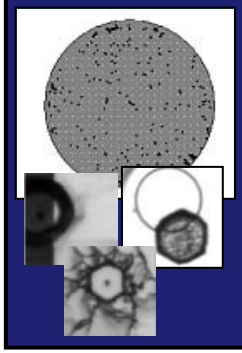
Yield Contribution to Defectivity
Kill ratio and potential die loss



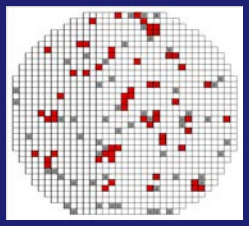


KLARITY LED © Software Development
Tool connectivity and yield management platform

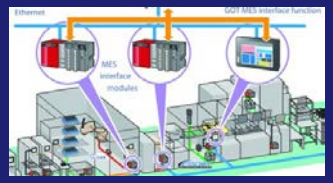
Inspection & Metrology



Yield/binsort/probe



Manufacturing Execution System (MES)



Process control analysis

KLA-Tencor

Key Milestones Progress:
HW: Candela 8620, SW: Klarity-LED Development

Year 1 Progress

- ✓ Development of Candela hardware
- ✓ Initial validation of increased sensitivity and classification
- ✓ Field testing

- ✓ Development of YMS engine and platform for tool connectivity
- ✓ Validation of DSA, SPC, and other functionality
- ✓ Field testing

Candela 8620

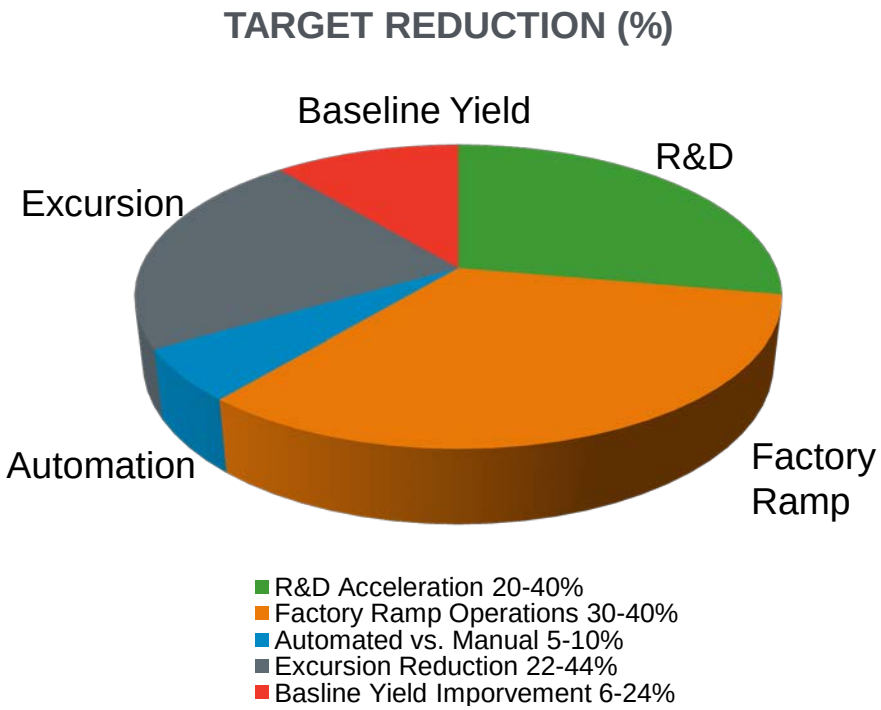
Klarity-LED YMS

Year 2 Objectives

- ✓ Field validation across multiple material systems
- ✓ Development of recipe algorithms
- ✓ Production robustness

- ✓ Field validation of tool connectivity
- ✓ Incorporate parametric yield information into analysis engine
- ✓ Production testing of process excursions, root cause and SPC

LED Manufacturing Cost Reduction from Improved Process Control



~50% total cost savings from in-line inspection (target 2015)

Summary

- DOE program on integrated automated yield management on track to complete by June ‘12
  - **Yield improvement value realized** => Best known inspection methods implemented with Candela 8620 at sapphire suppliers and LED device fabs
  - **Faster root-cause & excursion detection value realized** => Increasing transition from manual operators -> inline automated inspection; implementation of Klarity LED YMS in LED manufacturing environment

Candela 8620 Industry Recognition